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COMMON ANIMAL PARASITES INJURIOUS TO SHEEP

in Eastern Canada

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Common Animal Parasites Injurious to Sheep in Eastern Canada

Figure 1.

These lambs were the same age when the photo was made. The large lamb came from a flock that has been protected against worms. The flock from which the small lamb came received no treatment to prevent worm infection. The cost of treatment is less than 5 cents per head.

Published under the auspices of the Eastern Canada Society of Animal Production, as a contribution from the Committee on Animal Health.

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This publication issued by the Dominion Department of Agriculture, and the Departments of Agriculture of Quebec, Nova Scotia and Prince Edward Island. Additional copies can be secured from any of the above mentioned Departments.

FOREWORD

The well cared for sheep flocks in Canada, that is, those sheep that are given the protection of suitable buildings, abundant good feed, a frequent change of grazing ground and a suitable vermifuge at regular and appropriate intervals, should suffer but little from parasitism. Unfortunately many of the flocks do not receive the necessary care, but are left to shift for themselves under conditions that favor the advance of parasitism. We see all degrees of neglect in the care of sheep flocks and consequently we have all degrees of parasitism, from the "just noticeable" down the scale to "utter ruin" of the flock. Hence we see many flocks that pay but little profit to their owners. These worm-ridden flocks are often sold to farmers that are quite inexperienced in sheep husbandry. The sheep carry the parasites with them to their new home, and in spite of the change to new ground, the infestation is as heavy as ever at the end of a three year period. Under such conditions the inexperienced sheep farmer becomes discouraged and looks for a remedy or an outlet. Unless the sheep farmer has a knowledge of the numerous parsites and their life history, he is unable to institute methods of sheep management that will reduce and control the worm handicap. Internal parasites work in an insidious way, they are hidden from view, and unsuspected they carry on their destructive and parasitic existence. They have become increasingly numerous, until today but few flocks escape their ravages. The internal parasites take the sheep's blood, they take the sheep's food, they destroy the sheep's tissues and organs, they irritate the sheep beyond endurance, they poison the sheep with their toxins and they work hand and hand with disease producing germs to create conditions that bring the unfortunate parasitized animal down to its death. The work of the breeder and feeder is frequently defeated, due to the presence of parasites and the lack of the application of the principles of control.

Many thousands of lambs have perished needlessly on the farms of Eastern Canada during past years. Many thousands of lambs too light for slaughter reach the stockyards each year, between September and December, to be returned to country points for further feeding. These feeder lambs are light because of parasitic infestation, and represent a large loss to the industry in that they must be fed for an additional period. About twenty percent of the Eastern feeder lambs die between November and March, and those that survive make a very inferior carcase. A type of carcase is produced that can never make a "roast of lamb" popular on the dinner table. Many shipments of inferior wool go forward to the markets each year, gathered from sheep that have been left to suffer the misery caused by keds, lice and worms. Such parasitized sheep yield but three or four pounds of fleece and frequently abort their lambs, or produce a lamb that is too weak to live. It is to change this picture and help the sheep industry of Eastern Canada, that this bulletin is written.

SUSCEPTIBILITY OF SHEEP TO PARASITISM

In the struggle for existence parasites flourish where conditions favor them most. The body of the sheep offers so much that is essential to the well being of many of the lower forms of animal life, that no less than fifty-eight distinct parasitic creatures attack it successfully unless control measures are instituted by the shepherd.

The thin skin, well nourished by blood and carrying a warm covering of wool, offers a bountiful and well protected feeding ground, to the surface feeding parasites as ticks, keds, lice and mange mites. The blood vessels and skin supply the necessary nourishment to the parasites. The wool makes a well protected home in which countless generations of young parasites can be reared from very small beginnings. The wool of the sheep is a dense medium from which it is quite impossible for the sheep to cause dislodgment of the parasites. In this regard the sheep is at a greater disadvantage than the other domestic animals, the bodies of which are covered with a coating of hair that is shed twice a year along with its attached inhabitants.

The alimentary tract of the sheep, particularly the stomach, the small intestine, and the large intestine with their moisture, even temperature, wealth of digested food and vascular easily penetrated lining membrane, offer conditions highly satisfactory to the growth of the stomach worm, the hook worm, the tape-worm, the nodular worm and the whip worm. The lungs with their spongy delicate tissue, richly supplied with blood and lymph, offer a home that fills all requirements demanded for the growth of the three varieties of lung worm attacking sheep.

The practice of herding sheep in flocks or large bands, in buildings, enclosures or on the ranges that have been long used for sheep, expose them to the accumulative affect of the parasitic plagues. The continual mixing of the infested individuals with the other sheep that are susceptible tends to bring about a like condition of infestation throughout the flock.

(The failure of many stockmen to destroy the carriers of parasites, usually the poorer individuals, has done much to bring about the continued increase of sheep pest in this country.) The susceptibility of the sheep is so great and the parasitic trouble so wide spread, that very few lambs escape infestation. Parasites make miserable runty lambs and hard "ratty" looking sheep, that can neither be a pride nor a profit to any self respecting farmer.

PROTECTING THE FLOCK

The common knowledge that hill land is the best for sheep, is explained by the fact that the lower moist lands, offer more favorable conditions for the incubation of the eggs of the various worms that are parasitic on the sheep. Such lands with their more luxuriant vegetation also offer protection to a greater degree, to the young worms until they reach their host animal. On the hills the winds and the rain move a large part of the worm eggs to the lower areas, thereby concentrating the infective principle on the low ground. The scant vegetation of the hill lands permits the drying out influence of the sun's rays to create conditions unfavorable to the continued life of the worm egg and the young worm. The lower areas have shallow pools or swampy places formed by the water draining away from the higher areas. This drainage or surface water very frequently contains countless thousands of infective worm eggs or larva, and the lamb or sheep drinking such water is taking all the risks leading to worm infestation. Pasture fields on which small pools of water form after a rain are a source of danger, as the sheep will drink from such pools.

Sheep should be supplied with pure drinking water, preferably from wells and delivered into troughs that are well above the ground surface. Drinking from swift running creeks or springs offers but little danger of infection, but care should be taken to keep the sheep and lambs away from stagnant pools and ditch water.

Figure 2.

"Worms made the difference." Treatment costing less than 5 cents would have saved this lamb. It pays to treat the flock spring and autumn and to change the pasture frequently.

The old pasture lots, laneways, yards near buildings and old orchard lands that have been grazed by sheep for many years are responsible for much of the parasitic infection in sheep, as such old grounds are usually heavily seeded with the eggs of the various worms. Each "wormy" sheep is a spreader of worm eggs. Worm eggs and larvae are resistant to weather conditions and retain life for a considerable time. The blades of grass become contaminated with the young worms, and the sheep or lamb nibbling the grass will take them up not knowing the danger. The cleft lip of the sheep permits it to graze close, but the position of its eyes do not permit it to see just what it is taking into its mouth, therefore many encysted larva on grass or in the bodies of snails, beetles or flies are taken in and pass to the stomach of the sheep to be released there and start their life of parasitism.

Figure 3.

A light feeder lamb. Thousands of light lambs go to market each year. Worms are responsible for this condition. The subject of the photo was infected with five varieties of internal parasites.

Young animals suffer most. The young lamb is a tender animal and its tissues are easily injured by worm infestation. For this reason the lamb should be given a chance to keep free of parasites by allowing it to graze

on land that has not been contaminated by the droppings of "wormy" sheep. A lamb born of a "wormy" mother and permitted to graze over the same ground stands an excellent chance of being "wormy". Pollution of grass land comes quickly, as one sheep heavily infested with the common worms may distribute over the pasture on which she walks, as many as 10,000,000 worm eggs a day. Such wholesale "seeding down" of pastures, will indicate the necessity of frequent change of grazing ground, the resting of old pastures, the use of forage crops, the use of new grass seeding, the use of the dry lot method of rearing lambs, the use of vermifuges to destroy worms as well as the use of care and judgment in the purchase of either breeding or feeding sheep.

Figure 4.

Stomach worms, Haemonchus contortus, natural size. These worms when present in large numbers cause serious injury and may bring the sheep down to the point of death.

THE PARASITES INJURIOUS TO SHEEP

The Stomach Worm *(Haemonchus contortus)*

Description.— The Stomach Worm of Sheep is a very small thread like creature that is found in the abomasum (true stomach). It may also be found in the upper part of the small intestine in cases of heavy infestation. The male worms are less than three quarters of an inch long. The female worms may reach a length of one and a quarter inches. The Stomach Worm may be any shade of white in color or they may be white with a blood red coloration showing through the body wall. This worm is a blood sucker capable of bringing the sheep or lamb down to the death point.

Life History of the Stomach Worm.—The life of the Stomach Worm from egg to sex maturity is best considered in three stages, viz, the egg to larva, the larval, and the adult or sexually mature stage. The egg to larva, part of its life commences with the development of the egg from the germ cell to the condition of fertilization in the uterus of the worm. After the eggs are fertilized they are released from the uterus of the worm to mingle with the food in the fourth section of the stomach of the infested sheep. The worm eggs pass with the food and food residues until they reach the soil in the dung pellets. As many as 6000 Stomach Worm eggs have been recovered from a single pellet of sheep dung. Should the temperature and moisture conditions be favorable to worm egg incubation at the time the worm egg laden dung pellets are scattered on the soil hatching takes place and a little worm is released from each fertile egg.

This little larva feeds on the fecal matter surrounding it for three or four days and reaches larval maturity in that time if the weather conditions are favorable. Frost and dry weather destroy many of the eggs and very young larvae. Once full larval development is attained the little worm is protected by a chitinous coat or sheath. In this condition the larva can withstand the Canadian winter. The larva after leaving the dung-ball may ascend a blade of grass or attach itself to other vegetable debris near the surface of the soil, or it may be washed into a pool of water. In any of these positions the worm may be taken up by the lambs while they are feeding or drinking from surface pools. The young worm carried on grass or in water, on reaching the fourth section of the stomach is released from its protective coat due to the action of the stomach juices. Now free, the little worm attaches itself by its armed head to the stomach wall, and taps a bountiful food supply. The growth period of 14 to 21 days brings the worm up to sexual maturity.

The stomach worm will like all other worms die of old age in time. Its length of life is believed to be six to ten months. Sheep heavily infested in the autmun will, if they survive, carry fewer worms in the spring, in any part of the country where winter infestation does not take place, showing that the life of this worm is short.

Distribution.— The Stomach Worm is to be found wherever sheep are bred. Very few flocks are entirely free from the pest. Pastures contaminated by Stomach Worm infested sheep have been known to remain infective for a full year after the sheep had been removed. Pasture lands carrying a large number of sheep, each year for a long period are generally heavily infected with the eggs of this worm. A rest from sheep grazing for more than twelve months is required by pasture land if it is to become free of infection by natural methods. Plowing will turn worm infection on the land, down out of the way of grazing sheep. Permanent pastures perpetuate stomach worms.

Symptoms.— The presence of a few Stomach Worms will not create any suspicion of parasitism, but as numbers increase and the handicap becomes greater, the sheep or lambs will become unthrifty. The first symptom of the presence of Stomach Worm in the flock is the poor condition of the lambs, and the soiled rear quarters of many members of the flock. Many members of the flock will have an unthrifty appearance, pale skin and pale membranes. Very advanced cases frequently show a swelling of the lips, and also swellings on the lower jaw and brisket.

The fecal matter from sheep heavily infested with Stomach worm is usually coated with blood stained slime. The eggs of the Stomach Worm may be demonstrated by microscopic examination of the dung secured from sheep infested with this parasite.

A post mortem examination of the stomach and intestine of sheep will reveal the presence or absence of this worm. If present it will be found attached to the membrane. The worms are small and may be overlooked by the inexperienced.

Treatment for Stomach Worm Infection.— The sheep that are to be treated for the removal of Stomach Worm, should be prepared by with-holding all feed for at least 18 hours. They should also be kept from water for 6 hours before treating. This is important, because if the drug is to do its work the stomach and intestine must be free of food and excess water. Should it be necessary to drench lambs that have not been weaned, they should be deprived of their mother's milk for six hours, before being dosed. After dosing the sheep the starvation period should be continued for four hours. If lambs have been treated do not let them back with the ewes until two hours have passed after dosing. Mature sheep can be double dosed during cool weather, at one round-up, that is starve and deprive of water for 18 hours, administer the dose and continue to withhold feed and water for a further 24 hours, then administer the second dose and keep the sheep from feed and water for a further four hours before turning them back on the range. The drugs that are commonly used to destroy Stomach Worms are listed as follows.—

1. Copper Sulphate and Mustard, given in drench.
2. Tetrachlorethylene, given in capsule, as Nema Capsule.

3. Carbon-tetrachloride and Epsom salts, given in capsule.

4. Copper Sulphate, Tobacco and Sodium Arsenite, given as a tablet or pill.

5. Nicotine Sulphate, given as a drench in the strength of four tenths of one percent.

6. Copper Sulphate and Sodium Arsenite administered as a powder.

7. Carbon-tetrachloride, given with mineral oil or castor oil.

Figure 4a.
Stomach worm of sheep attached to membrane of abomasum.

The Copper sulphate and Mustard drench has been popular as a remedy against Stomach Worms, due to its cheapness, comparative safeness and ease of administration. In making this drench use a wooden pail or stone crock or an enamel-ware vessel of ample size, (two and a half gallons for 100 sheep). Measure out four ounces of Copper Sulphate, dissolve this by adding two quarts of hot water, then add four ounces of mustard and stir well, when this has been done, add two gallons more water. The total quantity of solution liquid or drench in the pail or crock will now be two and a half Imperial gallons. This quantity will dose 100 head of sheep once and allow for waste. The dose is as follows.—

For adult sheep, measure out 3 to 4 fluid ounces.
For lambs 2 to 4 months old, measure out 1 to 1½ fluid ounces.

For lambs 4 to 6 months old, measure out 1½ to 2 fluid ounces.
For lambs 6 to ten months old, measure out 2 to 2½ fluid ounces.
Measure accurately and keep well mixed.

In administering the drench, keep the sheep and the lambs together, this will prevent bleating while the dose is being given. Keep the sheep or lamb that is being drenched on its feet, do not sit them down, as such a position is a dangerous one for the sheep or lamb that is being drenched. Use a small thin necked bottle or fit a tube or rubber hose to any suitable bottle or funnel, to do the drenching with. A dose syringe is a very handy instrument in dosing sheep. To hold a sheep or lamb while it is being drenched, back it up into a corner and stand astride the neck. You can hold it in this position with your knees, leaving both your hands free to administer the dose. Do not raise the sheep's mouth above the level of its eye. Treat sheep gently and give them plenty of time to swallow. After a sheep is drenched, mark it or put in another pen, so that it will not be double dosed. All the drugs used against worms are poison and must be given in small quantity, so do not dose a sheep twice on the same day. Mistakes may result in killing the sheep. A little equipment to aid in handling the sheep, as hurdles, panels, woven wire and boards with which to make pens will save much time and labor.

Figure 5.
Administering a capsule or a pill to a sheep.

Tablets, pills and capsules are more difficult to administer by inexperienced hands than is the drench of liquid. A mouth gag or speculum and a forcep are required to properly handle tablets, pills and capsules.

Copper Sulphate and Tobacco are frequently given in drench liquid. The preparation is the same as for the Copper Sulphate and Mustard drench, except that but one ounce of Tobacco is substituted for four ounces of Mustard.

Copper Sulphate and Sodium Arsenite are used in combination by the sheep ranchers of South Africa, with a high degree of efficiency. This vermifuge requires a special set of measures for its administration. The two drugs are mixed in the proportion of four parts of Copper Sulphate to one part of Sodium Arsenite. The dose is as follows,—

For large sheep, 500 mgr Copper Sulphate and 125 mgr Sodium Arsenite.

For medium sizes sheep, 400 mgr Copper Sulphate and 100 mgr Sodium Arsenite.

For small sheep, 300 mgr Copper Sulphate and 75 mgr Sodium Arsenite. Tobacco infusions and Nicotine Sulphate solutions, containing four-tenths of one percent Nicotine Sulphate are given in doses up to four and one half fluid ounces to adult sheep, with fairly satisfactory results.

Considering cost, efficiency and safety in the farmer's hands the Copper Sulphate and Mustard drench is to be recommended for districts where there is no competent veterinary service.

Mass treatment is not generally very satisfactory in cases where the infection is heavy, but it is well worth its cost and should be used if individual treatment can not be applied. For mass treatment of a flock one pound of finely ground Copper Sulphate can be mixed with each 20 pounds of salt and the sheep allowed to lick at pleasure. Tobacco can be mixed with salt at the rate of one pound of broken tobacco leaf to each ten pounds of salt. This tobacco-salt mixture should be kept before the sheep and lambs at all times, it will keep many young worms from getting started. Copper Sulphate can be mixed with grain or pulped roots and given to sheep in that way with fair success. It is done as follows. Starve the sheep over night to get them empty, mix finely pulverized Copper Sulphate at the rate of, three ounces per 100 sheep, with one bushel of pulped roots. Keep the sheep from other food or water for six hours. If pulped roots are not available 25 pounds of finely ground oats can be used.

We have to fight worms with a poison, and Copper Sulphate is poison, so be careful that no animal gets too much. It pays to dose sheep individually and to employ skilled help as mistakes mean loss.

Prevention of Stomach Worm Infestation.—If at all possible keep the young lambs off the old pastures areas, lanes, unplowed orchards and grass areas around buildings where infested sheep have been running for years. It is a good plan to grow an autumn seeded forage crop as wheat and vetch or rye and use it for early spring pasture. This gives the lambs a clean pasture to start on. From the early spring

pastures the lambs should go onto newly seeded meadows or land that is growing sweet clover or alfalfa.

The use of the second growth on the meadows and grain lands after the removal of the hay and grains crops is always to the advantage of the sheep and lambs as the land is clear of worm infection. Tall growing crops for forage, as Dwarf Essex Rape, Soy Beans, Sweet Clover and other tall plants that will keep the sheep feeding above the danger zone, the surface of the soil, is to be recommended.

The use of a folding system as practiced in Europe is a very great help in the control of sheep parasites as the animals are moved to new ground before the worm eggs have developed to the stage infective to sheep. It is a good practice to keep the sheep moving from field to field as opportunity offers. Always feed from racks and water from troughs that are well above the surface of the ground. as such practice aids in worm prevention.

Flocks that are heavily infested should be drenched every month during the pasture season and a Tobacco-Salt lick provided them all the time. When unthrifty individuals appear in the flock cull them out as it is unprofitable to keep weakling runty lambs.

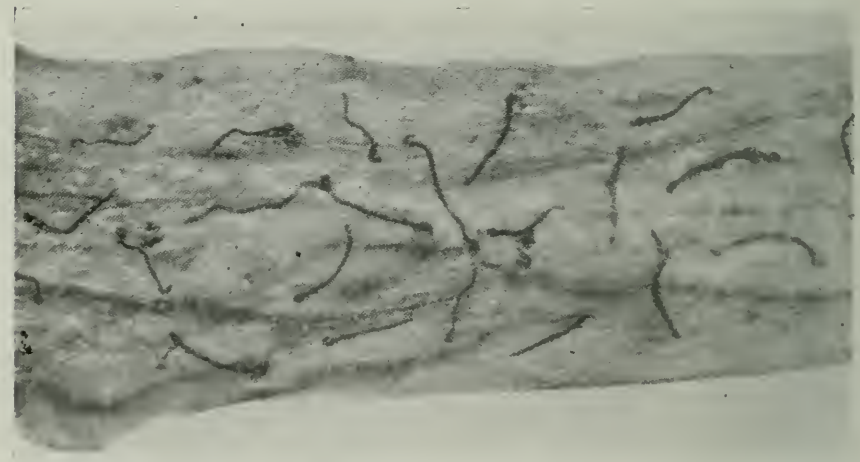

Figure 6.
Section of Intestine split open to expose Nodular Worms. Note "gate Hook" appearance of female worms. Natural size.

The Nodular Worm *(Oesophagostomum Columbianum)*

Description.— A small white worm that spends its adult life in the large intestine of the sheep. The males are one-half to five-eighths of an inch long. The females are a little longer than the males, being five-eighths

to seven-eighths of an inch. The head end of the female is bent and resembles a hook in outline. The body of this worm is of uniform thickness for the greater portion of its length. The head is armed. The eggs are oval in outline and very small.

The Life History of the Nodular Worm.— The Nodular Worm is principally found in its adult state in the large intestine, while cysts or nodules may be found spotted all over the intestinal tract and stomach. The life of this worm is best considered in three stages, the egg to larval, infective larval and sexually mature. The first stage begins in the uterus of the female worm while it is a resident in the large intestine of a sheep. The fertilized eggs are released from the uterus of the worm and pass along with the food residues reaching the soil incorporated in the dung pellets. If weather conditions are favorable to incubation the little eggs hatch in twenty four hours.

The newly hatched larvae feed on the fecal matter which surrounds them in the dung ball. They moult twice during the four or five day period while progressing to the infective stage. The young larvae are sensitive to unfavorable weather and many perish at the end of the grazing season, they are not winter hardy. Lambs and sheep pick up the young worms when feeding over land that has been occupied by "wormy" sheep. The young worms may be on the grass or in the water pools from which the sheep drink. Ewes that are nursing lambs may get their teats soiled with fecal matter containing the young worms. This fecal matter on being transferred to the mouth of the nursing lamb may cause infection. The larva on gaining entrance to the stomach and intestines of the sheep or lamb awakens to activity and at once burrows through the mucous membrane and invades the connective tissue lying between it and the muscle layer. The larva migrates aimlessly in the sub-mucosa and comes to rest at a time and in a location suited to its further development.

At the point where the larva finally stops a cyst forms that is at first watery, then a creamy yellow and eventually a hard yellowish-green-cheese like mass. These cysts become nodules due to the pus forming organisms that enter them from the intestine. Such nodules may become as large as hazelnuts. They give the intestine a nodular or knotted appearance. The young worm lives in a cyst for a period varying from a week to several months. It then re-enters the lumen of the intestine to complete its development. When the little worm leaves the cyst that it helped create in the intestinal wall it may be one-eighth of an inch long, it is very active and ready for a period of quick growth to sexual maturity.

Distribution.— That the Nodular Worm is very widely distributed in Eastern Canada, is indicated by the fact that but few sheep and lambs slaughtered in the abattoirs are found to be entirely free from it. The importations into Canada of sheep gut for sausage casing (to take the place of what we permit the Nodular Worm to destroy for us) has exceeded a million dollars in a single year. The author has examined over 2,000 sheep

and lambs and found but six of the number to be entirely free of Nodular Worm lesions.

Symptoms.—The adult Nodular Worms resident in the large intestine, apparently cause but little irritation to the sheep. The great injury done by this worm results from the habit of the larva, entering the intestinal wall and causing the development of the nodules. These nodules become centers of pus distribution, centers of irritation and gut weakness. The absorption that takes place from the numerous small pus centers in the intestinal wall, brings about a condition of toxemia or acute verminosis, that may reduce the animal to a condition of skin and bones. Severe irritation and acute pain may be caused by the rough edge of the nodules in contact with sensitive structures. Intestinal rupture followed by peritonitis is a common outcome of the destructive work of the young Nodular Worms. A light infection may not produce any noticeable symptoms, and since most of the sheep of the country are infested with two or more internal parasites it is difficult to attach the responsibility.

Figure 7.
Sheep heavily infested with Nodular Worms looks like this one. Note the poor condition of the fleece and general unthrift.

It is definitely known however that Nodular Worm can bring about a condition of general debility, with marked emaciation and anemia to be followed by death. Anyone who has seen the "terrible mess" that the Nodular Worm can make of the intestines of a sheep will not doubt its ability as a destroyer of sheep and lambs. The absorption of toxic substance from the pus centers (nodules) is very great. Some sheep will die, others will be hard looking and unthrifty. Thin individuals with a hard, stary wool appear in the flock. Later these hard looking sheep develop swellings beneath the jaw, throat and brisket.

Treatment.—The adult worm in the large intestine may be killed by the repeated use of either Tetrachlorethylene or Carbon Tetrachloride. The

treatment should be repeated every two weeks during the grazing season and the flock changed to fresh ground after each treatment.

The use of enemas made by mixing one gram of Thymol in 50 cubic centimeters of Gum Acacia solution has given good results. This treatment should follow a physic that has caused a rapid clearing of the bowel. The medicated enema is injected after the bowel has been cleared with warm water.

The young worms within the wall of the intestine are out of reach. There is no treatment to remove the nodules, which must remain during the life of the sheep. The lamb flock can at weaning time be given the Thymol-Gum Acacia enema and then placed on clean land where older sheep have not been for at least a year.

Prevention of Nodular Worm Infection.— To develop a new worm free flock from the old flock, proceed as follows, breed the ewes as early as possible that the lambs may be well raised before the pasture season arrives. Keep the ewes and their lambs in a dry pen that is well bedded with straw. Place all feed in suitable racks and take such precautions as will prevent the lambs feeding from a dung soiled floor. Arrange the troughs and racks so that fecal matter will not be carried in. Use sufficient clean litter to prevent the udder or teats becoming soiled with dung. This is important. When the lambs are four months old put them on grass or forage crop where other sheep have not been for at least a year. Never let the lambs when once weaned go back with the ewes. If the lambs are not old enough to wean when grass comes keep them in their clean pen until they are old enough. The ewes can be turned out to graze and they can be brought in twice a day so that the lambs can nurse. For this meeting of ewe and lambs a bare yard should be provided adjoining the one in which the lambs are kept. The sheep and her lambs meet in this yard for a very short time. After nursing the lambs are returned to their pen and the ewes to their pasture. The success of the method depends upon the thoroughness with which it is carried out. One hour of neglect will spoil weeks of good work. With a new flock of lambs on the farm all the other sheep should be disposed of at once and the pastures over which the old flock grazed should be rested for a year. A ram lamb can be reared for a flock header. Do not bring in any sheep from the outside as trouble may come with such. Keep the flock moving and don't over crowd the pasture area at any time. Provide forage crops for spring and autumn grazing to help out the native pasture and supply clean ground. The words "permanent pastures perpetuate parasites" should be painted on every sheep pen door.

The Hook Worm of Sheep *(Bunostomum trigonocephalum)*

Description.— The Hook Worm that infests sheep is a small yellowish or ivory colored worm. It is found in the lower portion of the small intestine. The Hook Worm is usually less than one inch in length.

Life History. The mature Hook Worms are found attached to the lining membrane of the intestine, being most abundant at the lower end of this organ. Fertilized eggs are released by the female worms. These eggs pass along with the food and are finally mixed in the dung pellets that are discharged from time to time.

When weather conditions are favorable for worm egg incubation, hatching will take place. The young worm feeds within the dung pellet for a time and then leaves it to enter the soil. Two stages are passed through by the young worm before it reaches the infective stage. Cool weather retards the incubation of the eggs and development of the young worms. After reaching the infective stage the young worm lives on or in the surface soil where it apparently awaits an opportunity to enter the body of a sheep or lamb. This is done when the sheep lies down on contaminated soil. The mode of entry differs from most parasites in that the young worm penetrates the skin at any point where it may touch the soil. Once through the skin the young worms enter blood vessels to be carried to the heart and lungs. From the lungs they migrate up the trachea to be swallowed and passed to the intestine, where they attach themselves and grow to maturity.

Figure 8.
Hookworm of sheep.

Distribution of Hook Worm.– The Hook Worm of Sheep is very common in Eastern Canada, being found in large percentage of the flocks that are not given the attention that goes with good sheep husbandry. The Hook Worm was imported into Canada with sheep from Europe and the United States.

Symptoms of Hook Worm infestation.— The symptoms of Hook Worm infestation in sheep are similar to those symptoms caused by the Stomach Worm. The Hook Worm brings about an impoverishment of the blood, and interferes with the nutrition of its victim. The sheep become anemic, weak, unthrifty and watery swellings sometimes appear on the dependent parts of the body. The skin becomes pale, the wool dry, short and poor as the infestation advances.

Treatment.—The measures recommended for Stomach Worm control are very useful against the Hook Worm. A flock that is regularly treated

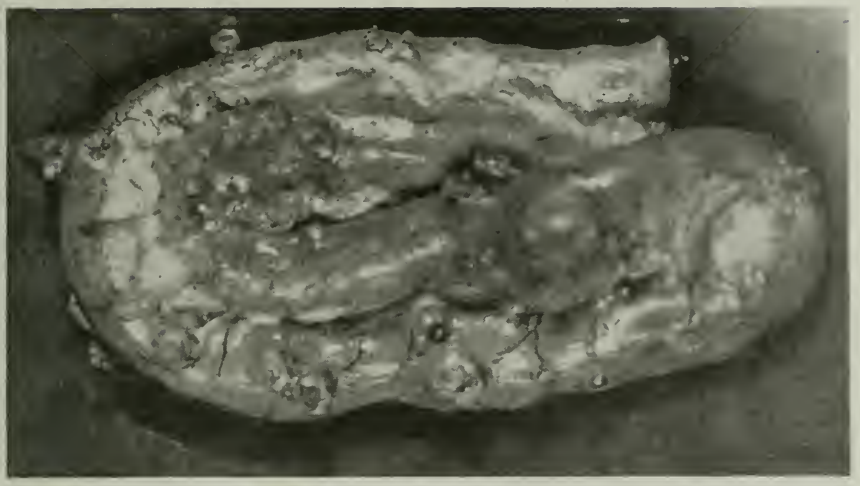

Figure 9.

Nodular Strongylosis — Section of intestine from sheep showing the lesions caused by the larvae of the Nodular worm. Note the small hard lumps on the intestine — cut these open and they are "gritty" if old — and filled with a "green yellow cheese like pus." The young worm that causes these nodules lives in them for a short time.

for Stomach Worm infestation is less likely to suffer from the presence of Hook Worm. The drug that has been found to be most effective against Hook Worm is Tetrachlorethylene, it is administered in capsule. Strict hygienic measures about the sheep yards should be maintained. Frequent changes of grazing ground will help in reducing infection. Old bedding ground should be plowed up or fenced off, as such spots are always dangerous. If sheep persist is sleeping in one place. make them move to a clean spot.

The Whip Worm of Sheep *(Trichuris ovis)*

Description.— The Whip Worm of sheep is a small white worm, that resembles a minute whip, hence its name. The head and neck end of this worm is a long hair like structure, while the body portion is of much larger diameter. The two sexes are about the same length, which is two or three inches. The female has a longer and more slender body than the male. The eggs are very small and in shape resemble the outline of a lemon.

Life History of the Whip Worm. The Whip Worm spends its adult life in the large intestine, where it is firmly attached by its head to the mucosa. The body portion of the worm floats free in the intestine. The eggs are discharged from the worm and pass from the sheep in the dung to infect the soil, yard space or feeding equipment.

Fig. 10.
Whipworm of sheep.

The eggs in an infective condition or the young larva is taken in by the sheep while feeding on short grass or from a dung soiled floor or by drinking surface water. The young worm once free in the large intestine attaches itself to the lining membrane by burying its long head and neck deeply into the tissue. In this position it reaches maturity in about twenty one days.

Distribution of the Whip Worm.— The Whip Worm is common in Canada. Large numbers of Whip Worm have been observed in the large intestine of lambs reared on old grass lands that have been used for sheep for many years.

Treatment and Control of Whip Worm.— Owing to the location of this worm in the large intestine, medicinal treatment has not proved very satisfactory. Effective control can only be obtained by preventive measures, already outlined for Stomach Worm, namely sanitation and frequent change of grazing ground.

The Tape Worms of Sheep *(Moniezias)*

Four species of Tape Worm commonly occur in the sheep in Canada, viz, the Moniezia expansa, the Moniezia alba, the Moniczia planissima and the Thysanosoma antinioides. The last named is not found in the Eastern Provinces, other than in recently imported sheep. The Moniezia expansa is the species giving the most trouble in the sheep of Eastern Canada.

Moniezia expansa—**Description.—** The head is small and pear shaped, the suckers projecting and slit like, the segments are broader than long and may reach the width of one half inch. This Tape Worm may be found in any size and length in lambs, frequently reaching eight feet. Tape Worms of different sizes and different ages may be found lying side by side in the intestine. As many as thirteen in such position have been noticed in a lamb.

Moniezia alba—**Description.—** The head is small with oval attachment discs, the segments are nearly as long as broad and may reach a width of three eighths of an inch. This Tape Worm is generally under five feet in length.

Moniezia planissima.—**Description.**— The head of this Tape Worm is small and nearly square in outline, the attachment discs are elongated and the segments are wide and short. The segments may attain a width of one half inch. This Tape Worm is usually less than three feet in length.

Thysanosoma actinioides.—**Description.**— The head of this Tape Worm is small and free of hooks. The segments are broader than long and

Figure 11.

Tape Worms — (Moniezias) taken from lamb two months old. Note the intestine has been dissected away in places to expose the worms. As many as 13 tape worms were found side by side. The intestine was blocked by the presence of so many worms.

have the posterior edge fringed. This is a small Tape Worm which invades the bile ducts of the sheep's liver, a habit that makes treatment very difficult.

Distribution of Tape Worm.— Tape Worm infestation is very common in Eastern Canada, and quite serious on many farms. Very few flocks are free from the pest and there are usually one or two individuals in every flock that act as carriers of Tape Worm. These same infested sheep are spreaders of Tape Worm eggs and keep sheep premises in a dangerous condition for lambs. Young lambs suffer most Tape Worm infestation. The intermediate hosts are not known.

Symptoms of Tape Worm infestation.— Lambs that become infested with Tape Worm during early life are generally hard looking, "pot-bellied," anemic looking creatures that are very light in weight. One Tape Worm

Figure 12.
A dirty hind end usually indicates parasitism in its early and middle stage. Constipation usually follows in the last stage of parasitism as the animals become weak and anemic.

present in the intestine of a lamb may not bring on noticeable symptoms of its presence, but a number of Tape Worms feeding within the lamb at the same time will make a runt out of their victim. Infested lambs have diarrhea in the earlier stages of infection, this is followed by weakness, emaciation and constipation as the infestation advances. Lambs may die due to the presence of many Tape Worms. Lambs that are infested with Tape Worm will pass the ripened segments of the worm out with the dung. The segments may be seen by anyone that takes the pains to look carefully over the faeces, at a point where the sheep have bedded down over night. The segments are small pieces of Tape Worm and when seen on the dung, may resemble flakes of bran. Sometimes quite long ribbon like strings of Tape Worm are expelled with the dung of lambs.

Aids to Expel Tape Worms.— It is difficult to remove the entire Tape Worm and unless the head or scolex is removed it will grow again. The portions that are easily removed are the segments or egg sacs. These should be destroyed. Prepare the lambs and sheep by with-holding food and water for at least 24 hours. Should the lambs be very young they can not be starved longer than six hours. The more empty the intestine and the stomach the more likely the drug is to do its part in removing the Tape Worm.

The following drugs are used to destroy Tape Worm with fair success, —Oil of Male Fern, Areca Nut, Kamala, Thymol, Pepo, and Copper Sulphate. Of these drugs Oil of Male Fern has the best record for efficiency in removing Tape Worm, but this drug must be used with care as a overdosing is dangerous. Oil of Male fern is generally given in milk. It should not be given in oils. The dose of Oil of Male Fern for a large lamb is one dram, small lambs are dosed in proportion. The Dose of Oil of Male Fern for a sheep is one to two drams according to size of the sheep. Areca Nut if fresh has some efficiency in removing Tape Worm from lambs and from sheep. The dose of Areca Nut for a large lamb is one dram. It is given in a drench. The dose of Areca Nut for small lambs is one half dram or less. The dose of Areca Nut

for mature sheep is, one-to one-and-a-half drams. Kamala is used with fair efficiency in removing Tape Worm. The dose of Kamala for a large lamb is three-quarters of a dram. The dose of Kamala for a grown sheep is one and a half drams. Kamala can be given in milk, gruel or water as a drench. Flocks that are regularly treated for Stomach Worm with Copper Sulphate-Mustard drench are less likely to be injured to any extent by Tape Worm, as this drench is fairly efficient in clearing the intestines of sheep of Tape Worm segments. See section on Stomach Worm for directions in preparing the Copper Sulphate-Mustard drench.

Prevention of Tape Worm Infestation.— The flock master should maintain hygienic conditions in the pens where the sheep winter. Keep the pens dry and well bedded with straw. Treat the flock for Tape Worm when you bring them in for the winter. Destroy all the discharges that come from the sheep after treating, for three days, then clean up the pens and yards for winter occupation. In the spring dose the flock again for Tape Worm, wait for three days and then move the sheep to new quarters. The dung from the pens and yards occupied during the winter should be plowed down. Move the flock frequently while it is at pasture. Use forage crops. Do not let the lambs graze over old grass plots that have been used by sheep during the past year. Plots around buildings, orchards, laneways and poultry yards are often heavily contaminated by wormy sheep, hence the necessity of keeping lambs away from such places. A sharp lookout should be kept for segments of the Tape Worms on the dung and when such are found, they should be burned or buried deeply. When sheep die the bodies should be disposed of in a way that will prevent dogs reaching them. Livers and intestines of sheep slaughtered and found to be infested with the Fringed Tape Worm should be burned.

Other Tape Worms Injurious to Sheep. —There are four or more Tape Worms that infest the dog and the wolf in their primary stage (adult). These same worms infest the sheep during their larval life, that is the sheep is the secondary host for the following: Taenia hydatigena, Taenia ovis, Taenia multiceps and Echinococcus granulosus. These Tape Worms grow to maturity in the intestine of the dog and of the wolf. The dog and the wolf are responsible for the distribution of the Tape Worm eggs over the pasture or woodland where the sheep feed. Considerable damage results each year through loss of sheep from this form of Tape Worm infestation.

Taenia hydatigena.— This is the adult Tape Worm in the intestine of the dog, the egg of which produces the thin necked Bladder Worm, found attached to the omenta, or liver or mesentary of any sheep unfortunate enough to have swallowed the egg. Several Bladder Worms may not cause any noticeable symptoms, but if a sheep or lamb picks up the eggs contained in one segment of the Taenia hydatigena, as dropped by a dog running over the pasture, the resulting infestation will surely kill the sheep. Sheep raised in back districts where wolves are numerous become more heavily infested with Bladder Worms than those raised elsewhere.

Taenia ovis.—This Tape Worm lives its adult life in the intestine of the dog. Segments of the Tape Worm are passed with the faeces of the dog and these contaminate the pasture grass and the water supply of the sheep's grazing ground. The eggs are taken up by the sheep or lamb while at pasture. The egg on reaching the intestine of the sheep liberates the larva, which when free penetrates the intestinal wall and migrates to various parts of the body by way of the blood stream or in the connective tissue. The larva eventually comes to rest and forms a small cyst in the muscle tissue. These cysts are about the size of a grain of wheat and white in color. Each cyst contains a head and a neck of a new Taenia ovis should it succeed in reaching a suitable host animal.

"Measly mutton" is the name given to any sheep carcase containing the cysts of this Tape Worm. All sheep carcases passing through the abattoirs where government inspection is in force, are examined for these cysts. All carcases in which cysts are found go to the tank, they are not used for food.

Taenia multiceps.— This Tape Worm spends its primary stage in the dog or wolf. Its larval or embryo form causes the condition known as gid in sheep. Sheep that graze over pasture areas that have been contaminated by dogs carrying the Taenia multiceps, will pick up the eggs of this Tape Worm. On reaching the stomach and intestine of the sheep the egg releases its embryo, which when free cuts its way through the wall of the intestine and enters a blood vessel to be carried to the brain and other tissues of the sheep. The surface of the brain is best suited to its development and here the embryo worm wanders for a time before settling down to complete its growth into the form known as the large Bladder Worm. This development takes about eight months. The irritation and pressure on the brain caused by the growing parasite brings about the following symptoms. The infested sheep are restless, always moving, may walk in circles, or the gait may be swaying and stumbling. The head is usually held in an unnatural position, frequently high, sometimes low and drawn to one side. The vision may be much deranged. Water and feed are generally refused. Infested sheep usually die about nine months after having picked up the eggs of the Taenia multiceps. May to August is the season when infection is most likely to be picked up.

Echinococcus granulosus. —This Tape Worm spends its primary life in the intestine of the human, or the dog or the wolf. The secondary or embryo stage is spent in the liver or the lungs of the sheep or the deer. It is sometimes found in other organs. In the sheep it occurs as a multiple Bladder Worm. It may be quite small or very large. The Bladder Worm contains a clear fluid in which a brood capsule is visible. No well defined symptoms follow the development of the Bladder Worm of the Echinococcus granulosus, as the cysts vary in size and location.

Treatment and Control. Treat all dogs that enter the pastures or frequent the sheep yards, with a suitable vermifuge every three months.

Destroy all dogs known to harbor the Echinococcus granulosus (Hydatid Tape Worm) and burn the body. Properly dispose of all sheep or the offal of any sheep that may die or be slaughtered on the premises. Sheep heads and viscera should be burned and not thrown out where dogs can get them. Sheep farmers should work to obtain such regulations as will bring about a safe disposal of the offal of all sheep slaughtered in country slaughterhouses.

The losses at the farm and at the abattoir, due to these Tape Worms, is considerable and humans sometimes become infested through close association with infected dogs or through using meat that contains the cyst form of the Tape Worm.

When an animal dies dispose of it at once by burning, in order that any parasites that it may harbor will be destroyed. Dead and unburied animals left lying where birds and dogs can feed are frequently the cause of the spreading of parasites that may be very injurious to the animals remaining on the premises.

The Thread Lung Worm of Sheep *(Dictyocaulus filaria)*

Description.–The Thread Lung Worm of Sheep is a small white worm that lives the greater part of its life in the bronchioles of the lung. The male worms are one and a half inches long. The females are larger than the males and may attain a length of four inches. The intestine is visible as a dark line for the entire length of the body. The eggs of this worm are quite large, oval in outline and contain well developed embryos when released from the uterus of the worm.

The Life History of the Thread Lung Worm.—The sexually mature worms are resident in the large air passages of the lungs. Here the female worm deposits her eggs, which at the time of release contain the embryo. In animals where the infestation is light and the lungs but little injured, the embryo is released from the shell while the egg is in the air passage. The young worm works its way up the trachea to be coughed out or swallowed. When the infestation is heavy and the lungs are in a congested condition, many of the eggs will be cast out before the completion of incubation. These may be found in the dung, or in the discharges from the nose or in mucous taken from the throat of the sheep.

Upon reaching the soil, the pen floor or the feed trough with favorable conditions of moisture and heat, the larval worms that survive go into a moulting stage. When the moulting is completed the larva becomes infective and any lamb or sheep swallowing them will likely become a victim of the disease pulmonary strongylosis (Hoose or Husk). It takes about ten days under favorable conditions, from the time that the larva leaves the lung until it reaches the infective stage. The young Lung Worm after reaching

the infective stage is very resistant to weather conditions and may live for many months on the pasture grass awaiting the coming of a sheep or lamb.

After being swallowed by the lamb or sheep the young Lung Worm reaches the intestine with the food, it then penetrates the wall of the organ and enters a blood vessel to be carried to the lungs where conditions for its development are favorable. It leaves the blood capillary in the lung tissue and enters an air sac and then the small air tubes. It grows to maturity in three or four weeks, moving meanwhile into the larger air tubes as its growth demands it.

Five or six weeks after the lamb has picked up the infective young Lung Worms, evidence of their presence will be noticed in the unthrift of the lamb. The adult life of the Lung Worm is believed to be over six months, as numerous worms are found on autopsy after the sheep have been off the land for five months.

Figure 13.
Lung Worms emerging from the air tubes in a freshly cut section of a sheep lung.

Distribution of the Thread Lung Worm.— The Thread Lung Worm is wide spread. Well managed flocks suffer but little from this parasite. Neglected flocks that continue on infected pastures get into a deplorable condition, and unfortunately such flocks are frequently found in every section of the country. Lung Worm is frequently introduced into a flock through the purchase of a breeding ram from an infected flock.

The practice of going to the stock yards of the large market centers for stock to be used for breeding purposes has been responsible for much of the spread of this parasite. The failure of sheep owners to remove unthrifty members from their flocks often results in the multiplication of Lung Worm trouble on the premises.

Figure 14.
A victim of Lung worm — An advanced case. Autopsy revealed much Lung Worm and a pneumonia condition. Nodular worm, Hook worm, and Stomach worm were also present in the intestine.

Symptoms of Lung Worm Infestation.— Lambs infested with this worm become unthrifty after being at pasture for about two months. In severe infestations there is a pasty yellowish diarrhoea, a hacking cough, the breathing is not normal, the wool is rough, the eyes watery and crusted,

and the nostrils dirty with a discharge from the lungs and nasal passages. The lamb has a tucked up and forlorn appearance. It rapidly loses weight, becoming just a rack of bones as the disease advances. Older sheep when infested with this Lung Worm show similar symptoms, except the diarrhoea. Should infested lambs survive the winter, they make small runty sheep, that can never be profitable.

A post-mortem examination of a lamb heavily infested with Lung Worm, reveals a condition of verminous pneumonia, with much of the lung tissue so altered that it cannot function. The worms are easily located in the air tubes, and the eggs and larvae may be seen in dung and mucous when such is examined under the microscope.

Treatment and Prevention.— In contesting the presence of Thread Lung Worm in the flock, the disposal of all factors that are detrimental to the sheep's well being is the first step. When the worms inhabiting the stomach and the intestine are removed the lamb is better able to withstand the ravages of the Thread Lung Worm. Strict attention to hygiene around the pens and feed troughs, frequent change of grazing ground, the extensive use of forage crops, are points that should be kept in mind by the sheep owner. The use of tall growing forage, such as rape and sweet clover, corn and soy beans, and second growth clovers to keep the sheep feeding above the surface of the soil are aids in preventing infection.

A Lung Worm will die when its mission in life is completed (producing eggs), and the lesions in the lung tissue of the sheep will heal and leave the animal in fair condition to continue life, if the flock master will do his part to prevent new infection getting into the sheep. The following treatments have been found useful in coping with Thread Lung Worm.

Causing the sheep to breath the fumes that are produced by burning or vaporizing such substances as, tar, sulphur, turpentine, and eucalyptus, or the spraying of vermicidal solutions directly into the trachea, and the use of respiratory antiseptics that can be given in feed or in drenches. The application of any treatment other than respiratory antiseptics in very advanced stages of Thread Lung Worm infestation is attended with some risk to the sheep as the reserve of normal lung tissue is frequently very small. Such sheep would probably die anyway, so treatment should not be withheld from the rest of the flock. The following intratracheal spray mixture has been used with success.—

Beechwood creosote	10 parts
Oil of Turpentine	20 parts
Chloroform	10 parts
Olive Oil	60 parts

The dose of this solution or mixture is 3 to 4 cubic centimeters, and it is *injected into the wind-pipe by a competent veterinarian.*

Another intratracheal spray that has merit is composed of the following,—

Iodine (metallic)	1 gram
Potassium iodide	10 grains
Distilled water	90 CC
Olive oil	200 CC
Oil of chenopodium	50 CC
Oil of turpentine	50 CC

The dose of this spray mixture is 3 to 4 cubic centimeters and it is *injected* into the trachea (wind-pipe) by a *competent veterinarian.*

The following substances can be heated to form smoke or vapor, which when inhaled will be irritant to the lungs and unfavorable to the worms in the air tubes,—sulphur, oil of eucalyptus, creosote, creolin and turpentine. Tar, sulphur and turpentine can be mixed in equal parts for vaporization, it is one of the standard mixtures in use. Such treatment to be of use, must be repeated frequently. A suitable building in which the flock that it is desired to treat can be confined is necessary for the application of the respiratory treatments. A building of suitable size, that is safe from fire danger and tight enough to make a concentration of fume possible should be selected. The animals are confined in the building, then the fume producing substance is carried in and suspended from the ceiling at a safe height, in a metal pail or other safe container, the door is closed and the sheep required to breath the fumes until they are all coughing, they are then released. The time required for treatment is about twenty minutes.

Care should be taken not to expose the sheep too long, as suffocation may result. The weakling sheep of the flock should be separated from the stronger and receive treatment by themselves. The attendant in charge should watch the sheep closely and be prepared to remove any that show distress without delay. The application of the respiratory treatment for Lung Worm is best carried out under the supervision of a veterinary surgeon. Drugs that have an antiseptic action when excreted in part through the lungs may be given as a drench. Such drugs are as follows,— Terebene, Oil of Garlic, Eucalyptus, Creosote, and Creolin. The dose of Terebene for a lamb suffering with parasitic bronchitis is one dram, given twice a day in a pint of milk. A combination of Terebene and Tincture of Camphor, one dram of each, in a pint of milk daily can also be used. The following formula has proven useful in cases of parasitic pneumonia and bronchitis.

Cod Liver oil	20 ounces
Terebene	2 ounces
Oil of eucalyptus	2 ounces

The dose for a large lamb is one fluid ounce of the mixture twice a day. Mix with a pint of milk and give as a drench.

The Hair Lung Worm of Sheep *(Prostostrongylus rufescens)*

Description.— The Hair Lung Worm of Sheep is a brownish-red hair like worm that lives in the smaller air tubes and lung tissue. The males are about three quarters of an inch long and the females from one inch to one and a half inches in length. The egg is of medium size and contains a visible embryo at the time of release from the uterus of the female worm.

Life History of the Hair Lung Worm.— The life history of this parasite is believed to be very similar to that of the Thread Lung Worm described in the previous paragraphs.

Figure 14a.
The dirty hind end usually indicates the presence of intestinal or lung worms. The sheep shown in this photo proved an autopsy to be heavily infested with Lung Worm.

Distribution.— The Hair Lung Worm of sheep is found less frequently than the Thread Lung Worm. However its distribution is wide and both varieties are found frequently in the same sheep. It is known to be very hardy to adverse weather conditions.

Symptoms.— The symptoms manifested in cases of Hair Lung Worm infestation are similar to those described for Thread Lung Worm in previous section.

A slightly different picture is revealed by post mortem examination. The Hair Lung Worm, its larva and eggs cause a localized pneumonia condition, distinguished by grayish yellow tumor like areas that vary in size up to three quarters of an inch across, frequently very irregular in outline and but slightly elevated above the surface of the neighbouring tissue. A microscopical examination of these areas will usually reveal the presence of the larvae.

Treatment and Prevention of Hair Lung Worm.— All animals known to be infested with Hair Lung Worm should be disposed of by slaughter as soon as possible. Weak or ailing sheep should always be removed from the main flock and given special care if it is decided to keep them for a short time. The use of bronchial antiseptics as advised in the

section dealing with Thread Lung Worm will help improve the condition of lambs. Shepherds should realize that animals with "wormy" lungs are weaklings and as such require good nursing treatment if they are to make gains or at least hold their weight while the infestation is dying out. Pure air, dryness underfoot and good feed are essential to recovery.

Hair Lung Worm *(Synthetocaulus capillaris)*

This Hair Lung Worm is smaller than either of the two Lung Worms previously described in this bulletin. The females are less than an inch long and brownish-red in color. The males are the same color and about one half inch in length. This Lung Worm spends the greater part of its life in the minute air channels.

The embryonated eggs are released in the bronchioles to complete their incubation. The released larva migrates out by way of the trachea, reach the soil, go through a moult and then become infective to any sheep that may take them up while feeding.

When the adult worms have completed their life work they bore into the lung tissue and become encapsulated. The nodules so formed may be felt with the fingers near the edge of the lung. They are small and rarely exceed the size of a pea.

Infection takes place as with the Tread Lung worm, so the same hygienic measures of control apply equally to this Hair Lung Worm. Bronchial antiseptics, a good tonic and clean dry living conditions for the infected sheep are helpful.

The Liver Fluke of Sheep *(Fasciola hepatica)*

Description. — In appearance the Liver Fluke of Sheep is a flattened, leaf like, oval shaped parasite that is less than an inch long. On the under surface at the head end there is a conical process in which is located the mouth surrounded by a sucker disc. Just back of the mouth a ventral sucker is to be found. The body surface of the Liver Fluke is covered with very minute spine like processes all of which point backwards from the head end. The purpose of these spines is to enable the Fluke to hold its position and also move forward in the bile ducts. In color the Liver Fluke resembles liver. The eggs of the Liver Fluke are very large, round-oval in outline and colored brown.

Life History.— The sexually mature Liver Fluke resident in the bile ducts of a sheep's liver, releases its eggs. The eggs are carried with the bile to the gall bladder, ultimately to the intestine and to the outside with the feces of the sheep. One Liver Fluke may produce 100,000 eggs. The eggs under suitable conditions of moisture and temperature go through an embryo producing process and eventually release a small organism that is capable of living for a short time in surface water. This organism attacks a snail of

the genus Limnaea and burrows into its body. While in the snail's body it undergoes a further development to a stage known as the cercaria. It leaves the body of the snail, swims about in the water for a time and finally comes to rest on a blade of grass, where it becomes encysted. These cercaria cysts are about one-sixteenth of an inch in diameter, white in color and circular in outline. Sheep grazing over swampy ground or along ditches pick up the blades of grass with the attached cercariae. The grass going the normal route into the stomach carries the cercaria cyst with it. The young fluke is released from the cyst, passes on to the intestine, which it penetrates to enter the abdominal cavity, here it wanders at large until it reaches the surface of the liver, which it penetrates to enter a bile duct. The little flukes migrate in the bile ducts to suit their growing needs, going from the smaller to the larger ducts.

Figure 15.
The Liver Fluke of Sheep. Mature specimens taken from the large bile ducts of the liver of sheep. In color, these oval flattened, creatures resemble liver.

Distribution.— The Liver Fluke depends upon the snail, and conditions favorable to the snail. So its presence in Eastern Canada is confined to the districts where the snails of the genus Limnaea flourish. Both the snail and young forms of the Liver Fluke require water and perish under dry conditions. Sheep grazing around water holes, sloughs and marshes, ditches and flood lands are very apt to be infested with Liver Fluke.

Symptoms.— A few Liver Flukes in a sheep's liver will not bring about any noticeable symptoms to indicate their presence, but heavy infestations will bring about a condition known as "liver rot." Sheep heavily infested lose condition, the appetite becomes poor, the animal is listless, dejected, the respirations are feeble and quick, edematous swellings may appear under the jaw, the brisket or the belly, and diarrhoea is usually present. Sheep may make fair recovery if the infestation is light.

An examination of a fluke infested liver will reveal the following, a soft rotten condition, an uneven or roughened surface, areas of scar tissue and enlarged bile ducts.

Treatment and Prevention.—Sheep should not be permitted to graze over ground known to be infested with Liver Fluke. The draining of wet pasture areas, to rid the land of the snails that serve as hosts for the develop-

ing flukes is recommended. The application of lime to infected pastures is helpful. Salting pastures is also practiced during June, July and August. The sheep should be provided with drinking water that is known to be free from infection. Flukes present in the bile ducts of the liver may be destroyed by administering Oil of Male Fern, Danistol or Carbon-tetrachloride. These drugs should be administered under the direction of a competent veterinarian.

The Nostril Fly of Sheep *(Oestrus ovis)*

Description.— The Sheep Nostril Fly which is the parent of the grubs causing the condition commonly spoken of as Grub-in-the-Head, is a little larger than the stable fly. The head of this fly is yellowish, the thorax is brownish grey, the abdomen is hairy, mouth parts are absent, wings are large and transparent, the winglets are large and white.

Figure 16.
The "grub" of the Nose Bot of sheep "Oestrus Ovis"

The larva of the Sheep Nostril Fly is yellowish white in color and is composed of eleven or more segments. When fully developed the larva are three-quarters of an inch in length and one third of an inch in diameter. The larva is provided with a strong pair of mandibles, that give them a secure hold on the membrane lining the sheep's nasal passages during the eight or ten months of larval life.

Life History.— The adult fly does not feed, so its life is short. After leaving the place of pupation, the female fly seeks a mate. The fertilization of the eggs being attained, the female fly leads a lazy life, during which the egg incubation goes on toward the development of young larva that are destined to live an independent life as soon as they are discharged from the body of the mother fly. (In this advanced stage of multiple pregnancy).

The female fly seeks a flock of sheep on which to bestow her progeny. Upon finding a sheep that is willing to stand, the fly deposits the young, living larvae on the edge of the sheep's nostril, one at a time making frequent thrusts as long as the sheep will stand. In this way one fly may unload as many as sixty little grubs on one sheep.

The young grub crawls upward in the nostril of the sheep to come to rest at some suitable point in the nasal passages. The grubs cause consider-

able irritation, resulting in an outpouring of serous fluid and mucous, on which the grub is nourished during the long period of larval life, eight to ten months. When fully developed the grubs loosen their hold on the membrane, to be shaken or sneezed out by the sheep in her efforts to dislodge them. Reaching the soil the grub which is quite active seeks cover in the loose dust or top soil to go through the last stage of its development, emerging from its pupal case in four to six weeks as a two winged fly. Some grubs do not succeed in getting out of the nasal passages while alive. Those that die, decompose and are thrown out through a fistula or with the other nasal discharges.

Distribution.— The Sheep Nostril Fly came to Canada with the importations from Great Britain many years ago. It is quite common in all sheep districts and has spread to the wild deer in the back districts. All persons familiar with the normal actions of sheep, know when the fly is about and attempting to deposit its larvae. The fly during flight makes a peculiar buzzing note, which together with its quick movements about the sheep's head cause much alarm. The sheep try to avoid the fly by crowding together and keeping their heads down. If many flies are working the sheep run about, sneeze and rub their noses in attempt to offset the tickling caused by the presence of the recently deposited larva. Sheep will run into thickets, long grass or shade or hold their heads low in a furrow bottom if such is available, in order to keep its nose out of reach of the fly.

Symptoms.— The symptoms indicating the presence of the grub in the nasal passages of the sheep, vary with the numbers present, and the general health of the sheep. Strong sheep in good condition are not affected as severely as weaklings or sheep in poor condition from lack of feed. One grub will cause but little trouble, while twenty or more grubs will create much irritation and a condition of "snotty nose" develops and continues as long as the grubs are present, in the nasal passages. The infested animal shakes its head, sneezes and rubs its nose, thereby trying to dislodge the grubs.

During the early stages of infestation the symptoms are those of a cold, a running nose and sneezing. This early stage of misery advances as the grubs grow and bacterial complications set in, until a severe catarrhal condition has developed. The air passages are partly plugged making breathing difficult. The presence of large amounts of purulent material brings about a condition of toxemia, that keeps the sheep unthrifty as long as the grubs remain. In severe infestations the animals may die.

Treatment and Prevention.— The use of lime dust, sulphur fumes, benzine, eucalyptus, turpentine or other irritants that produce violent sneezing and stimulate heavy mucous secretion give some relief to infested sheep. The spreading of dry lime over the pen floor and then causing the sheep to mill around and inhale the lime particles is sometimes practiced. The fumes of tar-sulphur-turpentine vaporization as recommended for lung worm treatment is also useful against the grub of this Sheep Nostril Fly.

The injection of irritants as turpentine or benzine into the nostrils of the sheep to bring on violent sneezing and activity on the part of the grub is sometimes quite effective in bringing the grubs out. Grubs can be removed by surgical interference, but this is expensive and can only be applied to highly valuable sheep. Protection is always better than treatment and the little labor required is always well repaid in the thrift of the flock.

Sheep running on bare fields where there is no natural cover or shrubbery into which they can go during the heat of the day, can be protected by applying pine tar to their nostrils each week and by plowing shallow furrows across the field, into which the sheep can dip its nose when the fly is about. Salt and feed troughs can be so constructed that the sheep will keep its own nose smeared with pine tar, thus saving the labor of hand work. Such a trough can be made by boring holes, three inches in diameter and five inches deep into a cedar log of suitable size and length. The holes are filled with salt and pine tar smeared around the edge of the hole frequently enough to keep it sticky and in good condition to mess up the sheep's nose when she comes to lick the salt. Sheep running on pasture land where there is an abundance of tall grass or other forage plants, as sweet clover, alfalfa, or have a wood lot into which they can go are seldom bothered by this pest.

The Sheep Ked *(Melophagus ovinus)*

Description.— The Sheep Ked, commonly called the Sheep Tick in Canada, is a reddish brown insect infesting the skin and wool of sheep. The females are one quarter of an inch or more in length and about one eighth of an inch across the abdomen. The males are a little smaller than the females. The body is hairy and has a hard covering. Three pairs of short strong legs are attached to the thorax. These legs are furnished with grasping claws useful to the Ked in making its way through the wool. The abdomen is oval or nearly round in outline and quite large.

Life History of the Sheep Ked.— The female Ked gives birth to living young, seven or eight days after having mated. The newly born larva is enshrouded in a soft whitish membrane, which is quite sticky and serves to attach it to the wool. On aging the membrane covering the larva changes color, becoming a chestnut brown and also quite hard. In size and shape the newly liberated larva resembles a radish seed. In warm weather the period of development takes place in less than 20 days, while during cold weather and on exposed sheep it may take 40 or more days. The pupa may remain attached to the wool or it may fall to the floor of the pen or soil. The young Ked should it fail to get back onto another sheep or lamb will perish. When the wool is long the pupa is not likely to fall from the sheep but remain there and complete its development. On the other hand during the short wool season after shearing, many of the pupae will fall off and perish. This is one reason why the Ked is more abundant during the winter.

It takes on the average about 30 days for the newly hatched larva to develop to sexual maturity.

Sheep Keds are found wherever sheep are kept in domestication. The life of this insect is spent entirely on the sheep's body, the one exception being the few that may fall from one sheep to gain a position on another or the migration from ewe to lamb. The Keds being without wings and having legs not well adapted for speed do not travel very far. Their migrations consist of transfer from sheep to sheep when the wool offers a bridge during close contact. Removed from the body of the sheep the Keds will die in eight days, on the other hand the pupa can live apart from the sheep if the weather is cool and the transformation thereby delayed.

Damage from Ked Infestation.—The irritation and worry caused the unfortunate sheep by this insect, is sufficient to remove all chance of profit from the flock, unless allayed or removed. The proboscis of the Ked is lance like and penetrates the sheep's skin, this is accompanied by pain and the injecting of an irritant salivary secretion. Itchy red pimples appear at the point of penetration, these remain for a day or more. Heavy infestations

Figure 17.

Sheep Keds or "ticks." This pest causes much misery and unthrift in sheep and lambs. Be humane and dip the flock at least once a year — better twice a year. The sheep will pay for it — in better wool and better lambs.

may show from 14,000 to 20,000 Keds on a single sheep. Thrift is impossible under such a handicap. Heavily infested sheep usually die as their resistance is so reduced that they fall easy pray to other parasites and bacterial diseases. The wool from heavily infested sheep is much lower in value than that from clean sheep, as it is of poorer staple, stained with excrement, broken pupal cases and debris of Keds long dead. All this has to be removed by extra washing and carding, which requires time and money. Hence the sheep owner that neglects to dip his flock has to take a lower price for his wool crop.

Treatment and Control.— Dip the flock in September and again in 24 days. If the work is well done the sheep will be free of Keds and in better shape to stand the winter and the other parasites that may occupy the stomach, intestine or lungs. Keep other sheep away. If you bring in a new ram, dip him twice before turning with the flock. The breeding ability of Keds indicates that double dipping should be practiced, as most of the common dips in use have little or no effect on the pupae. The second dip gets the Keds that have emerged between dippings. If but three young Keds escape, a male and two females, a population of 1200 may develop on one sheep in six months time. Sheep pens should be thoroughly cleaned out after the sheep go out in the spring. Spraying such pens with a strong disinfectant is always good practice and will head off trouble that might come later on.

People working with infested sheep should be invited to stay away from clean flocks until such precautions are taken to eliminate the danger of carrying infection. Trouble can be carried from farm to farm at shearing or any other time by thoughtless people.

Dip solutions made from coal-tar creosote, lysol, cresol, creolin, nicotine-sulphate, and lime-sulphur-arsenic compounds all give excellent results against Keds if properly made up and applied with thoroughness. Commercial dips offered to sheep men by the trade, if of well known and reliable brands are easier to work with than a dip made up on the farm. Such commercial concentrated dip fluids and powders, can usually be obtained through firms handling stockmen's supplies and through organizations formed to serve the sheep industry. For those sheep owners having very small flocks and desiring to prepare a dip solution from materials already on the farm, the following formulae are given.

Soda Emulsion.— To make the stock solution, dissolve one pound of hard soap in two gallons of boiling water, remove from the stove, and while very hot add two gallons of coal oil. Mix well by stirring and pouring, or by forcing through a spray pump. To use, dilute this stock solution by adding eight gallons of warm soft water for each gallon, that is four gallon of stock solution is added to thirty two gallons of warm soft water, making a total of 36 gallons of dip ready to use.

Milk Emulsion.— To make the stock solution, to two gallons of milk add four gallons of coal oil, mix thoroughly in an old churn or by forcing through a spray pump. This makes the stock solution. To use, add the six

gallons of stock solution to 48 gallons of warm soft water, making a total of 54 gallons of dip ready to use. These home made dips while not giving the same efficiency as the best commercial dips, are very cheap and can be made up quickly from materials always on hand on the farm. In the spring the Keds migrate from the ewe to the lambs and much annoyance for the lambs will follow. The early spring is a time when the dipping of sheep can not well be carried out and some other means of keeping the Keds in check must be used. A powder that can be rubbed into the lambs wool will give some relief and make it possible for the lamb to thrive until dipping can be done. The following powder is very useful to hold lice and Keds in check.

Napthalene	1 ounce, powdered
Hellebore	1 ounce, powdered
Sabadilla seed	3 ounces, powdered
Tobacco dust	3 ounces, powdered
Sulphur	2 ounces, powdered
Boracic acid	3 ounces, powdered

Mix well and apply with a shaker, or with a dust blower, while the wool is parted by an assistant.

The Biting Louse of Sheep *(Trichodectes ovis)*

Figure 18. *Biting lice, (Trichodectes ovis)*

Description.— The Biting Louse of Sheep may be distinguished from the Sucking Louse and from the Foot Louse by its head, which is as broad as long, and by the single row of hairs on each segment. The abdomen is white in color and the head reddish. The male is about one twentieth of an inch long. The female Louse is slightly longer than the male.

Life History of the Biting Louse.— The sexually mature female louse releases her eggs on the wool, quite close to the skin of the sheep. The eggs being quite sticky adhere to the wool on drying. Hatching takes place in five to ten days according to the temperature at the point where the egg is attached and the conditions under which the sheep is living. Sheep with open fleece and exposed to the cold do not offer as favorable conditions for incubation of the lice eggs as do the close wool sheep or sheep sheltered by warm buildings. The young lice grow to sexual maturity in about two weeks time under average conditions, or in nine days under very favorable conditions.

Treatment and Control.— Flocks that are regularly dipped twice a year are not likely to be troubled with biting lice, unless they are exposed to infection. The same dipping that serves to kill the Keds or so called

Sheep Ticks, suffices to control the lice. In neglected flocks where the regular dipping practice has been overlooked, lice can be held in check during the winter period by dusting Sodium Fluoride through the wool. The quantity required is one half ounce per sheep. Keep the Sodium Fluoride away from the eyes and nose of the animal. The loss of wool, of mutton and lambs due to the irritation set up by the lice is considerable each year. In very severe infestations the ewes will abort their lambs and the wool crop may be reduced by more than fifty percent.

The Sucking Louse of Sheep *(Haematopinus ovillus)*

Figure 19
Sucking Louse
x 30.

Description.— The Sucking Louse of Sheep is much larger than the Biting Louse. It has a longer and narrower head. With the Sucking Louse each segment of the abdomen has two rows of hairs. The female Sucking Louse is about one twelfth of an inch long. The abdomen and the thorax in both sexes are white.

Life History.– The Sucking Louse feeds by puncturing the sheep's skin with its proboscis and drawing blood from a vessel within reach. The sexually mature females release their eggs, which adhere to the wool fibres quite close to the skin. The eggs under favorable conditions incubate in from ten to eighteen days. Cold weather, exposure and open fleece delay the hatching process. The young lice grow to sexual maturity in fourteen days, mate at once and produce more eggs to keep the species going.

Description.— Sucking Louse of Sheep is widely distributed and found in poorly cared for flocks in all parts of the country.

Treatment and Control.— The use of sheep dips as recommended for the destruction of Keds. For winter infestations when dipping is not easily carried out, the use of the following powder is recommended.

Napthalene	1 ounce, powdered
Hellebore	1 ounce, powdered
Sabadilla seed	3 ounces, powdered
Tobacco dust	3 ounces, powdered
Boracic acid	3 ounces, powdered
Sulphur	2 ounces, powdered

Mix well and apply, one-half ounce to each sheep, with a shaker can or blower, while the wool is held apart by an assistant. The wool saved will pay the cost of the treatment many times.

The Mange Mites *(Acarina)*

The Mange Mites that infest sheep, persist in flocks that are not given close attention and regular dipping. They do considerable damage in some sections. The three varieties of Mange Mite doing damage in Canadian flocks are, the Psoroptes communis ovis, the Sarcoptes scabei ovis, and the Chorioptes ovis. The Psoroptes communis ovis which causes "Sheep Scab" is not known to exist in the Eastern provinces. The Sarcoptic and Chorioptic forms of Mange Mite confine their attacks to the hairy areas of the head and legs of the sheep.

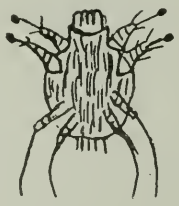

Figure 20.

Sheep Scab Mite. *Head Mange Mite.* *Foot Mange Mite.*

Description.— These mites are very small, fifty male mites placed head and tail would measure one inch and eighty male mites placed side by side would occupy one inch. The female is a little larger than the male. Both sexes are oval in outline and are equipped with four pairs of legs. The female mite has the first, second and fourth pair of legs terminating in a sucker disc and numerous hairs. The third pair of legs terminate in two very long hairs. The male mite has each leg terminating in a sucker disc.

Description.— The "Scab Mites" feed on the surface of the skin. Copulation is followed by egg production. The pregnant female mite may produce any number of eggs up to twenty five, or under certain conditions give birth to nymphs. In event of eggs being deposited on the surface of the skin which is generally the procedure, they hatch under favorable conditions in a period that usually does not exceed seven days, liberating a six legged nymph. After further changes the young mites become sex mature in six to ten days and reproduction again provided for. The increase is rapid. Frequently the female mite will produce a batch of eggs, and then go into a state of rest to recuperate for further egg production. This may happen several times with one female.

Symptoms.— The presence of "Sheep Scab" mite on the sheep is followed by intense itching. The sheep are noticed rubbing against trees, posts

or on any object on which they can get relief. The mite may be found on any part of the body that is wool covered, but the back, loin and rump areas are usually favored by the mite. The lesions are small when first found and if examined closely with a hand lens are noted to be covered with a yellowish or yellowish brown crust. The infested areas become enlarged, centers spread, to unite and form large irregular patches. The skin becomes scurfy. The mites migrate to fresh skin as the older infested areas become dry and bare of wool. The skin becomes dry and wrinkled. The wool becomes ragged due to the rubbing and scratching and much of it falls off leaving bare areas of dry scabby skin. Pregnant ewes may be so irritated by the mites as to cause them to abort their lambs. Any lambs born alive have a very poor chance while "Scab Mite" is present in the flock. Scrapings are taken from the infested areas and examined with the aid of a microscope in diagnosing sheep scab.

Treatment.— Should a flock be known to be infested with Sheep Scab Mite (Psoroptes communis ovis) it must be reported to the Federal Health of Animals Branch Inspector for the district or to the Veterinary Director General, Department of Agriculture, Ottawa. Control of Sheep Scab is undertaken under the supervision of the Health of Animals Branch, and all infected and contact sheep must be treated under the official supervision, with a Lime-Sulphur dip. The dip is prepared according to the following.

Flowers of Sulphur	24 pounds
Unslacked lime	10 pounds
Water	100 gallons

In preparing Lime Sulphur Dip, the lime is slacked to a paste condition and then the sulphur is added and well stirred in. This mixture, or lime-sulphur paste is then put in a kettle with 30 gallons of water to boil for two hours or more, being well stirred during this boiling. After boiling the mixture is poured into a barrel having a spigot a few inches from the bottom. When the settling is completed the clear liquid is drained off for use and water is added to make up to 100 gallons before use. The temperature of the dip at time of use should be 105 degrees fahrenheit. The specific gravity of the dip at time of use should be 1023.0 At least two treatments are necessary at ten to fifteen days interval.

The Head Mange Mite *(Sarcoptes scabei ovis)*

Distribution.– The Head Mange Mite is about half the size of the Sheep Scab Mite described in the last section. This mite is nearly round in outline and is equipped with four pairs of legs. The first and second pairs of legs on the Head Mange Mite terminate in a sucker disc that is attached to the end of a medium length stalk. Numerous hairs also adorn these legs. The third and fourth pairs of legs terminate in a single long hair.

Life History.— The sexually mature and fertilized female burrows into the surface layers of the sheep's skin at a point on the head where the covering is hairy. In the burrow or gallery made by the female, her eggs are released. Incubation and subsequent moultings to bring the young up to sexual maturity takes about two weeks. This change from egg to fully developed mite takes place in the burrow or gallery located in the skin of the infected sheep. The fully developed mites come to the surface of the skin to mate. Following mating the males die and the fertilized females seek locations for new galleries.

Symptoms.— Intense itching. Small nodules form on the surface of the skin due to the burrowing habit of the female. These nodules progress to the pupae development stage and then rupture leaving the skin in a scaly crusted condition. A red raw surface is exposed on removing the scales. The infested areas increase in size and the skin thickens with the extension of the scab area, leaving it rough and hard.

Treatment.— Use the following.

Sulphur	2 pounds
Oil of Tar	8 ounces
Raw Linseed Oil	1 gallon

The sulphur, tar and linseed oil are heated together in a large pot, and are not allowed to boil. This mixture should be well rubbed into the skin. In ten days the areas are washed with soap and warm water, then they are dried and the ointment again applied.

Foot Mange of Sheep *(Chorioptes ovis)*

Description.— This mite is oval in outline. It is smaller than the Head Mange Mite. The first, second and fourth pairs of legs each terminate in a sucker disc that is attached to a very short stalk. The third pair of legs terminates in two very long hairs on each. This mite attacks the hairy areas of the feet and legs of sheep.

Symptoms.— A sheep infested with the Foot Mange Mite will bite the skin of the legs, stamp its feet or rub the point of irritation with its nose. The surface of the skin where the mites are working becomes bare and red-grey crusts form, that may become wart like. The Foot Mange Mite usually attacks the areas below the hock and knee, giving preference to the region of the fetlock. The goat may be infested with this mite over its entire body.

Treatment.— Use the same treatment as advised for the Head Mange Mite. See previous section.

Ticks *(Acarina)*

The true Ticks infesting sheep are differentiated from the so called "Sheep Tick" by having many differences in body structure and life his-

tory. The true Ticks are causing less injury to sheep in Canada than any of the other parasites mentioned in this bulletin, and are found only in the back districts. Lambs should be examined frequently during the spring and early summer, for the possible presence of Ticks. These when found should be carefully removed, preferably by soaking the Tick well with a light oil. Do not pull them as the heads will break off and cause a wound that is difficult to heal or may become fly blown. An application of a mixture of crude oil and pine tar may be placed along the backs of lambs as a repellant against the Wood Tick.

Sheep Maggot Flies

There are a number of species of flies in Canada which deposit eggs or larvae upon the wool or skin of the sheep. These flies seek out conditions that are likely to be satisfactory for the development of the next generation of flies. The larva or maggot as the young is called is responsible for considerable damage each year, as the condition known as "struck" "maggoty" or "fly blown" is rather a disagreeable one for the sheep or lamb. All the various flies attacking sheep are peculiar in that, while their normal breeding place is the flesh of a dead animal left lying exposed, they are not slow in depositing on living sheep.

The Blow Fly *(Calliphora vomitoria)*

Description.— This fly is a little larger than the common house fly. In color the abdomen is bluish-green with a metallic lustre. The eyes are brown.

The Flesh Fly *(Sarcophaga sarraceniae)*

Description.— In color this fly is a light grey with black markings, resembling the common house fly. The eyes are reddish-brown and the body is covered with stiff hairs which give this fly a spiny appearance.

The eggs of the Blow fly may be deposited in wounds or on areas that are chafed or inflamed. During warm weather the eggs hatch quickly, releasing in a few hours a young larva or maggot. This maggot feeds in the wound for three to nine days and then pupates in any handy position on the sheep or it may drop off and enter the soil. A period of three weeks or more is required for development from egg to egg production by the new fly.

The female Flesh Fly deposits her larvae upon wounds on inflamed areas that are protected by wool. The larvae or maggots create conditions favorable to themselves and complete their larval life in about six days, in the wound. They crawl to a shelter when ready to pupate, and go through

the development that brings them forth as living adults in twelve days, all ready to mate and provide for the next generation.

Prevention and Treatment of Flesh Fly Injury.—All dead animals on or near the premises should be burned at once or buried deeply to insure such being out of reach of the flesh flies. By removing every possible breeding place, the number of flies in the district will be reduced to the vanishing point. Keep the sheep in as clean a condition as possible. Prevent soiling of the skin or wool with fecal matter. Keep the lambs away from chicken yards and pig yards where flies congregate. Clip away any tags of soiled wool and swab areas so treated with a creolin solution. All wounds, inflamed areas and chafed areas should be protected with a pine tar dressing. If the sheep must be handled, see that a shepherd's crook is used to guard against any chance of wool pulling. Should any sheep or lambs show evidence of being blown they should be removed from the flock and given such surgical treatment as will remove the maggots, cleanse the wound and protect it from further injury.

A disinfectant wash that is very useful can be made by adding three parts carbolic acid to ninety seven parts water. Dressings containing pine tar should be applied after the wound has been cleansed. A careful watch should be kept over the flock during warm weather as these flies have a way of finding every scratch however small. A small wire cut may become a very ugly wound if a female Blow Fly finds it.

APPENDIX

The Salt and Tobacco Lick

A Salt and Tobacco Lick can be made, which is very useful as an aid to the prevention of parasitism in sheep. Its efficiency while not the highest, is well worth the cost in that it keeps down the numbers of stomach and intestinal parasites. It is made as follows,—

Salt	100 pounds
Crushed tobacco leaf	10 pounds

The tobacco leaf should be dry in order that it may be broken up in a size equal to wheat bran. The salt and tobacco are mixed together and just enough water added so that the tobacco will stick and the salt settle into a firm cake. If sheep are not used to tobacco, then start them off with a smaller percentage of the leaf, or mix a little wheat bran or crushed oats with it to get them taking the mixture. The quantity of tobacco can be increased as the sheep get used to it.

The Salt and Copper Sulphate Lick

A salt and copper sulphate lick can be made to serve the purpose of an aid in keeping down stomach and intestinal parasites. It is made as follows,—

Salt	100 pounds
Copper Sulphate, finely pulverized	5 pounds

The finely pulverized Copper Sulphate is mixed dry with dry salt. If more than five pounds per hundred pounds is used sheep will not take to the mixture very freely. Salt licks should be prepared during the winter and boxed in suitable containers, ready for the pasture season. A salt lick containing either tobacco or Copper-sulphate, or both these drugs should be within easy reach of the sheep and lambs every day of the year. All salt boxes in which prepared or medicated salt is used, should be provided with a roof board or cover to keep the rain and snow out.

The Salt-Tobacco-Quassia and Copper Sulphate Lick. A very good Lick for Sheep, that will prevent worm infestation in the stomach and intestines, can be made according to the following.

Salt	35 pounds
Epsom salts	20 pounds
Tobacco, pulverized	25 pounds
Quassia, powdered	5 pounds
Slaked lime	4 pounds
Copper Sulphate	5 pounds
Foenugreek	5 pounds
Beta-Naphthol	1 pound

This mixture must be kept in a suitable trough, located in a shed away from rain or other moisture. Let the sheep lick as they want it.

These salt licks will not clean up a "wormy" flock, but are useful as aids in keeping a flock relatively free of stomach and intestinal parasites, providing the flock is in fair shape and is being given good care. Weakling members of a flock, often the most heavily parasitized sheep, will not use a salt lick to which drugs have been added. Such sheep must be dosed by hand.

Mineral Mixture Suitable for Sheep

A suitable Mineral Mixture containing a small amount of iodine in some form should be available to sheep and lambs at all times.

Salt	50 pounds
Sulphur	2 pounds
Oxide of Iron	1 pound
Ground limestone	20 pounds
Potassium Iodide	¼ to 1 ounce.

Mix and place in a self feeder box, that the sheep may help themselves, or feed two pounds of the mixture with each 100 pounds of grain.

Tonic Suitable for Sheep recovering from worm infestation.

Sulphate of Iron	2 ounces
Gentian	4 ounces
Powdered Licorice root	6 ounces
Powdered Salt Petre	1 ounce
Powdered Nux Vomica	3 drams
Linseed meal	4 ounces.

Mix and give in a little meal, one tablespoonful twice daily, or mix with a little water or milk and give as a **drench.**

Do not keep too many sheep together, better divide the flock, and give the weaklings a chance. The sheep has a good winter coat and can stand cold, if the air is dry and pure. Sheep should have a dry place to lay down, out of the wind. Damp floors and moisture laden foul air, as is sometimes found in cow stables is destructive to sheep. The shepherd should know every sheep and lamb in the flock, he should also be able to detect the first symptoms of parasitism in the flock, and have enough good sense to head off any prospect of trouble. Don't give the flock up to the worms, better protect the sheep and reap the profits yourself.

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